UNIV. OF MICHIGAN,

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no. 28

BULLETIN No. 28—1908

BUREAU OF EDUCATION

THE MILKFISH OR BAÑGOS

(*Chanos chanos* FORSKÅL)

ITS CULTURE IN THE FISH PONDS ABOUT MANILA BAY AND THE GULF OF LINGAYEN, ISLAND OF LUZON

PREPARED BY

WILLIAM D. CARPENTER

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EXPLANATORY NOTE.

The following monograph on the milkfish, or bañgos, and its culture in fish ponds was prepared three years ago by Mr. William D. Carpenter, at that time teacher of the science studies in the intermediate school at Malabon. It is published by the Bureau of Education because of its practical value. It is believed that it may properly form a subject of instruction in the science work of the sixth or seventh grade of the intermediate schools in towns where natural conditions offer opportunity for the construction of fish ponds and the rearing of the bañgos, as this industry is at present conducted on the shores of Manila Bay. One of the most important services which intermediate schools may render to a community is to awaken pupils' interest in various kinds of private businesses that are within their means and capacity to conduct successfully. There appear to be many kinds of small businesses capable of affording comfortable livelihoods to young Filipinos who have the necessary intelligence, energy, and training. In urging young men to undertake the fish-pond business and the raising of the bañgos, inquiry should be made as to whether the fry of the bañgos is obtainable or can be transported to the region where the fish-pond culture is to be introduced. The spawning habits of the bañgos do not seem to be well known. The fry are seined off the coast of Marinduque, the west coast of Bataan, and presumably also in the Gulf of Lingayen.

For more than two years the Bureau of Education has had under consideration the establishment of a school of fisheries at Malabon. The building for this school has already been completed. Definite announcement of the opening of this school can not at present be made, but it is hoped that it may be organized before the opening of another school year. A bulletin descriptive of its work and containing a discussion of Philippine fisheries is under preparation by Mr. William F. Montavon, the division superintendent of Rizal.

As stated above, this bulletin will be furnished in sufficient numbers for class work in such intermediate schools as desire the instruction. In the case of young men who contemplate entering this business, it is recommended that they make a visit to Malabon where they will be assisted in making a personal study of the industry.

DAVID P. BARROWS,
Director of Education.

PREFACE.

In presenting this article to teachers in the Philippine Islands with the purpose of encouraging the increase of the fish-pond industry, no attempt is made to point out how a school pond should be constructed; the facts are laid before the reader with the belief that more good will be obtained by varied and individual experiment than by directions, suited, perhaps, to but few localities.

It is desired to here express indebtedness to the learned authorities of the Colegio-Universidad de Santo Tomâs de Manila, who kindly—but, it is to be regretted, fruitlessly—made search in their archives for historical data in connection with the subject of this article, and graciously permitted perusal of their copy of Dr. Gunther's Catalogue of the Fishes of the British Museum.

This article is emphatically preliminary, and has been prepared before much valuable and essential literature on the subject could be received. Incomplete description of the fry, due to the inappropriate season, will be noticed.

Criticism and corrections will not only be welcomed, but are requested. Such, together with the accounts of success or failure in pond experiments, will aid in amassing a most important knowledge of this subject.

W. D. C.

MALABON, RIZAL, P. I.,
November 1, 1905.

THE MILKFISH, OR BAÑGOS.

(*Chanos Chanos* FORSKÅL.)

The bañgos (*Chanos chanos* Forskål) is one of the most, if not the most, important of the food fishes of the Manila market; and its fishery undoubtedly represents the largest outlay of capital of all the Philippine fisheries.

In introducing this subject we begin with a description of the milkfish, or bañgos.[1] A specimen 39 centimeters in length, from a fish pond at Malabon, Rizal, may be described as follows: Body rather long, oval and moderately compressed; the general appearance suggestive of a herring or shad; the length rather more than four times the depth; the belly somewhat flattened. Upon each side near the center, the very distinct lateral lines extend in almost a straight line. The color in life is silvery white, shading to dark olive gray on the back with various deep greenish, bluish, and iridescent reflections; the belly and throat have some cream color. The back fin and tail fin are of the color of the back, but pale; the lower fins with some yellow. None of the fins have sharp, spiny rays. All the fins are provided with scaly sheaths, those of the paired fins being widely separate posteriorly. The fin of the back begins in front of and ends nearly opposite the posterior paired fins. The single fins have their last rays lengthened; but not so much by one-half as is the third ray. The single fins usually have about the following number of rays: that on the back, sixteen; that below the tail, ten.

The head is slightly shorter than the depth of the body and is not scaly. The head is three and three-quarter times the length of the eye, which latter is beneath a large, transparent "imperforate, adipose eyelid.'' The skin of the head continues beyond the cheeck (opercle) in a membranous margin, which continues beneath in nearly a straight line, thus uniting the opercles for their entire length and being also not attached to structures beneath it. The mouth is small and fleshy with no teeth, but with a slight tubercle on the lower jaw.

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[1] For a more critical description and references, see notes appended to this article, entitled "A More Critical Description," etc.

The fry are at first very elongate and resemble the adult but little.

Specimens more mature than that described differ from it in little except that the width increases slightly upon the other proportions.

It is said that this fish occasionally attains a length of 5 feet. It is widely distributed about sandy shores of the Pacific and Indian Oceans from the Hawaiian Islands to south of New Caledonia, and from the Red Sea to the coast of Central America.

In ''The Aquatic Resources of the Hawaiian Islands,'' by Jordan and Everman, published as Volume XXIII, Bulletin of the United States Fish Commission, the authors speak of the milkfish (*Chanos chanos* Forskål) as one of the most important food fishes of the Hawaiian Islands. ''It is, next to the mullet, the most common species frequenting the artificial ponds, into which it runs with the mullet and with the tide and is restrained in the same way. It is known by different name at different sizes.''

Again, in another bulletin of the United States Fish Commission, reprinting a paper by K. Mitsukuri, the following statement is found: ''In Formosa * * * the native Chinese engage in the culture of various species of fish * * *. Of these, two stand out prominently. One species, belonging to the Clupeidæ and called in Chinese 'sabahi' (*Chanos salmoneus* Bloch & Schneider), is abundantly cultivated in the southern parts. Although a sea fish, it is able to accommodate itself easily to fresh water. The fish are at first, when small fry, put into ponds not more than 4 feet square and fed with hens' eggs. When grown to a larger size, in twenty to thirty days, they are put in larger ponds, given plenty of food, and when they reach the size of 10 inches or more are put on the market.'' (Synonymous with *Chanos chanos* Forskål. This fish has been described as *Chanos chanos* from Giran, Taihoku, Toii, etc., in Formosa. See Proc. U. S. Nat. Mus., Vol. XXV, p. 327.)

THE BAÑGOS PONDS ABOUT MANILA BAY.

Maestro Gregorio Cornel, son of Domingo Cornel, the reputed originator of the bañgos industry, has furnished an historical sketch in Tagalog, from which the following translated excerpt is taken:

> In 1863 in the southeast of the town of Tambobong (now called Malabon, Rizal) was the barrio of Concepción. It is the only place where there were salt-water fish ponds in central Luzon. There were two ponds with high dikes; one belonged to Rufina Quimson and the other to Domingo Cornel and Maxima Ignacio. In Dampalit, northwest of Malabon, there were also two ponds where shrimps were raised.
>
> Domingo Cornel was born in Tambobong and burried in Navotas. "Old Domingo" experimented with his fish pond. He placed the fry of the bañgos in the pond, together with tarpon, mullets, and other fish. Then he observed what fish ate the bañgos, what was the food of the bañgos, and what were their habits. In the month of May, Domingo took a trip to sell some goods in Santa Cruz de Malabon, Cavite (called at that time Salinas), whence he returned with twelve jars of fry. They were the biggest jars of that time, any one of which would contained 4 gantas of water. He put these fry in his pond and sold them to Monica Tacio when they became large. This was the first time that money was gotten from a pond of bañgos. After this he sold many.
>
> Epifanio Hernandez became somewhat rich; he ordered the mangroves of Gasac and Dampalit to be cut off and fish ponds built, and he began to get much profit from the fish ponds.
>
> After this "Old Domingo" ceased to think about bañgos. He dug deep his fish pond and experimented with various other fishes that were more valuable and worthy indeed of being given as presents, so that at the time of his death his fish pond had become famous.

About the low shores of Manila Bay are numerous fish ponds, or "palaistaan," devoted to the raising of bañgos. By far the largest and most important tract lies just north of Manila, beginning at the municipality of Caloocan and extending through Malabon, Navotas, Obando, Polo, Hagonoy, and Malolos for more than 10 kilometers, and with an estimated average width of more than 1 kilometer. There seems to be no trustworthy map showing the fish ponds. Both the Bureau of Lands and the Bureau of the Treasury have at present no statistics relative to these fish ponds and thus information is based largely upon the testimony of native residents and particularly upon that of one surveyor who has surveyed many of these ponds for their owners and has done for them much valuable and trustworthy work. This person estimates the total area devoted to bañgos ponds about Manila Bay to be more than 15 square kilometers. He explains that this is a difficult estimate to make at this time, as the restrictions of the recent internal-revenue tax upon alcoholics have had the effect of making the nipa swamps less profitable, and owners are rapidly beginning to transform many of these swamps into fish ponds. This is especially true of Pampanga, and, to a less extent, of Bataan and Cavite Provinces also.

From an interesting notebook on a visit to Bataan Province the following memorandum on the fish ponds is furnished:

> At Mabatan near Abucay, formerly a pueblo, now a barrio, a large number of fish ponds are already made in the nipa swamps, with others under construction. Fish when very small are bought at Bagac (on the China Sea) at ₱4 per thousand, brought here and placed in these ponds; ₱20 invested in these fish may amount to ₱4,000 or ₱5,000 in a year. This fish is the "bañgod" and the corrals, or ponds, are called "palasdan."

The average value of ponds about Manila Bay is probably 40 centavos per square meter, giving a total valuation of more than ₱6,000,000 for the ponds alone (undoubtedly a conservative estimate). From a surveyor's map compiled from data obtained from the owners of the properties, one pond measuring 140 by 170 meters was found to be of the average size of twenty or more shown. The subdivision of ponds is hereinafter explained.

THE FRY; THEIR CAPTURE AND TRANSPORTATION.

The fry of the bañgos, or "kawag-kawag," are caught in small scoop nets made of close-meshed hemp fiber, by waders in the shallows and on the small beaches in the Provinces of Zambales, Bataan, to a lesser extent along the shores of Manila Bay and to a greater extent along the entire coast of Batangas. The shores of the small sea of which Marinduque Island is the center are said to furnish more kawag-kawag than any other section. Luzon, Marinduque, and Mindoro each furnishes its quota to the Manila market.

Good authority states that in one instance eggs of the bañgos washed up on the beach were hatched out in an old banca partially filled with water. This would seem possible, since the *Chanidæ* (milkfishes) do not seem to be far removed from the *Clupeidæ* (herrings) in form or habits.

When captured, the young bañgos are placed in large earthenware jars, or "palyok," of perhaps a half meter diameter, and are then loaded upon fast sailing paraos, which under most favorable circumstances may reach Manila in twenty-four hours. In Manila, local banqueros procure them and peddle them from their bancas throughout the maze of esteros that intersect the fish-pond region.

A palyok retails at from ₱4 to ₱5, varying with the number and size of the fry and the condition of the market. The quantity and quality of the fry are determined by holding a white porcelain cup beneath the surface of the water in the palyok and noting the fry which swim above it. The kawag-kawag are usually purchased by the "isang lacsã," for which ₱20 to ₱25 are paid. ("Isang lacsã" is the Tagalog for ten thousand.) Five palyok make an isang lacsã lot of kawag-kawag; thus one palyok should contain 2,000 of the young bañgos.

The fry vary in size; some recently examined from a palyok measured, on an average, 14 millimeters in length by 1.5 millimeters in depth. In this lot the yolk sack was not as yet entirely absorbed.

The number of kawag-kawag sufficient to stock one hectare is six lacsa (60,000), of which, under favorable conditions, 5,000 should attain the size of marketable bañgos. As the fish develop they are thinned out, if overcrowded, and transplanted to other ponds. It is a good percentage if 33⅓ per cent of the kawag-kawag attain marketable size. The fry are sold from April to August (mostly in the earlier part of the season).

The owners of some of the smaller ponds buy kawag-kawag and keep them for six months, allowing them no food other than that obtained from the water, which is changed at frequent intervals. When the bañgos planted under more favorable conditions have been marketed, these fry whose growth has been retarded are purchased for ₱20 per thousand and transferred to the larger ponds. There is always a demand for these fish.

Food supply seems to be the most important factor in the growth of the bañgos. The size of the pond seems also to have a marked effect, which may prove to be due to the cooler temperature of the larger ponds, or to a greater amount of microörganic food in the larger quantity of water. The very important investigations of the salinity of the water have not as yet been started, as salinometers ordered from the United States have not yet arrived. A slight change in salinity has marked effect upon many fish. This would not seem to be true of the bañgos, however.

MARKETING THE BAÑGOS.

About four months after planting, under the most favorable conditions, some of the bañgos attain a length of 25 centimeters, such normally retailing for 9 centavos. In eight months under the same conditions the bañgos will measure about 40 centimeters and bring a price of 20 centavos; a baňgos which has been well fed for a year should be nearly half a meter long and should bring 50 or 60 centavos at market. The sizes most commonly for sale bring from 10 to 20 centavos.

The fish are prepared for market one week before catching by beating the water of the pond with bamboo poles. This so frightens the fish that they leap from the water in all directions and, it is said, will not eat for several days thereafter, resulting that when caught their entrails are empty. In this condition natives eat entrails and all. Should a typhoon destroy the fish weirs upon which the ordinary market supply of fish depends, the baňgos are caught immediatly to meet the demand of the market, under these circumstaces often bringing 30 centavos each.

ARRANGEMENT AND CONSTRUCTION OF PONDS.

Many owners and lessees have a complete system of ponds in which the whole process from planting fry to capturing for the market is consummated. Ponds vary much in shape and size according to location and other local conditions; for description here, a rectangular pond is taken.

A complete system should have at least four ponds. These ponds should be so constructed that one pond equals the area of the other three ponds combined. Usually the area of the large pond is much greater. The dikes of the small ponds are low, often not 30 centimeters above the water level. These smaller ponds are of about equal size, usually rectangular, and each of about 200 square meters in area. The palaistaan are formed by throwing up dikes. The main dikes are large and frequently mangrove trees (*Rhizophora mucronata*) are planted for their protection.

The water from the estuary is permitted, when the tide is flowing, to enter one of the smaller ponds through a sluice (''prinsa''), usually constructed of masonry and with two gates—one of several slides of solid wood for controlling the water and the other of close bamboo palings to prevent the egress of the baňgos and the ingress of undesirable tenants, such as carnivorous fishes and crabs, which burrow into the dikes and cause leakage. Snakes and birds are also evils that have to be constantly guarded against. This small pond distributes the water supply to the other ponds and is used for capturing the marketable baňgos. This pond is usually separated from the large pond by a close paling of bamboo around the narrow opening in the partition dike. When it is desired to capture the fish in the largest pond, the paling is removed and a strong current is caused to flow from the small pond to the larger. The bañgos, attracted by the fresh water, swim against the current and in great numbers enter the smaller pond, where they are readily captured in a seine. This operation is often accomplished about midnight so that the fish will reach Manila markets in the best condition for early morning sales.

The remaining two ponds are subdivisions of the pond area inclosed within the limits of the boundary dikes and are connected with each other and with the pond which feeds the water by single pipes made of the hollow log of the luyong (*Diospyros nigra* Retz). These tubes are called "palabunbuñgan." The water and fish are controlled at these pipes by a solid wooden plug or a funnel of bamboo strips.[1] The water in these two small ponds is kept at a level of but a few decimeters, the ponds being used interchangeably for cultivating the food "alga" (*Oedogonium sp.* ?) and for developing the kawag-kawag.

THE FOOD ALGA; ITS GROWTH, VALUE, AND PREPARATION.

The food of this fish is an "alga" and has been identified by the Bureau of Sience as an *Oedogonium*[2] (oögamous *Confervoideæ* of the class *Chlorophyceæ*, green algæ.)

If it is desired to cultivate the food alga, the water is allowed to drain off and the clay exposed to the full power of the sun. The alga rapidly makes its appearance, and a little water is then permitted to cover the bottom. This is gradually increased as the *Oedogonium* develops. It seems to thrive best upon a clean, clay bottom. If the bottom is covered with a deposit of dark mud, or if, in an old pond, a black, evil-smelling deposit has formed, the bottom is scraped clean with a board. This operation is not done necessarily at any particular season, but whenever demanded by the conditions.

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[1] Upon the low dike shown in the frontispiece are two wooden plugs and a bamboo funnel.

[2] Strassburger, Noll, Schenck, and Schimper in a "Text-Book of Botany," in part have this to say of the *Oedogonia:*

"The numerous species of *Oedogonium* consist of unbranched filaments; each cell of which possesses one nucleus and a single parietal chromatophore composed of numerous united bands. The sexual swarm-spores are formed singly from the whole contents of any single cell of the filament and escape by the rupture of the cell wall. For the purpose of sexual reproduction, on the other hand, special cells become swollen and differentiated into barrel-shaped oögonia. * * * At the same time other, generally shorter, cells of the same or another filament become converted into antheridia. Each antheridium gives rise either to one or, as is more generally the case, to two spermatozoids. * * * They penetrate the opening in the oögonium and fuse with the egg-cell, which then becomes transformed into a large, firm-walled oöspore. On the germination of the oöspore its contents become divided into four swarm-spores, each of which gives rise to a new cell filament. * * * In some species of *Oedogonium* the process of sexual reproduction is more complicated, and the spermatozoids are produced in so-called dwarf males."

The *Oedogonium* is sometimes purchased and placed in an exhausted pond. A small banca load is worth ₱1. A so-called medicine for the young fish (apparently used only in small ponds where the water is contaminated by close proximity to houses) is the *Lemna* (sp. ?), the floating roots of which are greedily devoured.

If the fry are to be planted in the pond, the water is again allowed to drain off and the alga is partially killed by the hot sun. This, it is claimed, renders the *Oedogonium* soft and fragile for the tiny mouths. Eventually the young bañgos are removed to the great pond, where their quantity is largely governed by the supply of food alga. The water in this pond, and in the small pond where they are congregated for capture, is usually about waist deep. It is said that the larger the pond the more rapidly and the larger the bañgos grow.

EMPLOYEES OF FISH PONDS.

A fish pond is watched, cared for, and frequently its product is sold by a man whose nipa house is perched solitarily upon the dike. This man sometimes receives, especially from the smaller owners and lessees, as high as two-thirds or one-half the market proceeds. The larger pond owners employ special men to catch the bañgos and others to market them.

MISCELLANEOUS NOTES.

The Tagalogs consider the Bulacan fish to have the finest flavor, but owing to greater accessibility to the Manila market of the ponds about Malabon, fish from the latter are the more valuable. The value of a pond is much lessened if it have no direct communication with an estuary but must wait upon the convenience of an intervening pond for its water supply. With some of the ponds about Navotas, a quicksand foundation under the dikes militates against the value.

Shrimps are sometimes planted in the fish ponds, and frequently part of a system is arranged for evaporating salt during the dry season. Sea water is partially evaporated in a large pond and then allowed to flow into a smaller pond with tiled floor where the evaporation is completed.

It does not appear that the bañgos have ever been known to breed in the ponds, although the experiment has been tried of keeping a few individuals for several years.

The adult fish, 4 or 5 feet in length, are reported as being caught, though in no great abundance, in deep-water seines and fish weirs. The fish are then called "sâbalo" and are said to be very powerful, sometimes breaking through the fish weirs or jumping over the high sides. A sâbalo may bring a peso or a peso and a half at market. By data obtained from various sources, there is reason to believe that there are bañgos and sâbalo in Lake Taal, where they are called "limulocso." Indeed it is said that Lake Taal furnishes many of the kawag-kawag sold about Manila. This report is well worthy of investigation, as perhaps a strain better suited for fresher waters might be there obtained.

FISH PONDS IN BATAAN PROVINCE.

The practices in the Bataan section differ in but little from those above described. The following excerpts from the letter of a careful observer in that section give some interesting details

> Ground not sandy and near salt water is the best kind on which to construct a fish pond. If the ground has a growth of trees, these should be cut down about 2 feet above ground. At the end of six months the tree roots will have become sufficiently rotted for easy removal of the entire stump.
>
> Ponds may be made of different sizes; generally they are constructed in the form of a square, 75 meters on a side. The wall or dike should be built of earth with a strong and close bamboo partition half as high, and so separating the two halves of the wall that it may not be gradually destroyed by the passage through from side to side of crabs and other burrowers. A canal somewhat above low-tide mark should be cut from the wall to the sea. The part of the pond next the wall should be equally deep with the canal.
>
> The food alga is started by the high tide carrying and depositing upon the table, or tables, spores from the sea. During low tide the table is clear of all except spores and these grow readily under the influence of the sun's rays.
>
> The best and most common fish is the bañgos, and the fry are brought here from Bagac and Morong on the China Sea. The fry are caught in seines at the mouths of rivers on the sea mentioned. (A very few of these tiny creatures—so small that little more can be seen in the water than two eyes

and a black spot in the center of the body—make their way in to Manila Bay and are carried into the ponds by the tide.) After being carried over the mountains in earthen jars, the fry are placed in small corrals inside the pond and kept there till strong enough to look out for themselves. The beginning of the wet season is the proper time to deposit these minnows in the pond; they grow very fast so that the supply of fish soon becomes, and remains, large enough to meet the demand.

The fish here are marketed both in the towns of this province and in Manila. The prices in the local markets are generally lower and always more variable than in Manila. A large part of the fish on the markets from this town (Balanga) are caught in the sea, not in ponds.

The best kind of water for the ponds is a mixture of salt and fresh. The proportion should be about one part of fresh water to three parts of salt. This can be regulated easily enough by the proper arrangement and manipulation of the opening or door in the wall between the canal and the pond proper.

FISH PONDS ABOUT THE GULF OF LINGAYEN.

In the Province of Pangasinan are extensive areas devoted to fish ponds of both fresh and salt (or brackish) water. The greatest area devoted to the latter is to be found about Dagupan, where the Agno River forms an extensive delta system before pouring its waters into the Gulf of Lingayen. This large river carries so much fresh water in the rainy season that it makes the growth of the food alga difficult at certain points. At the barrio of Bunuan in 1901, according to one of the largest pond owners in that barrio, most of the nipa swamps were converted into fish ponds; but now (October, 1906) perhaps more than half have been reverted to the nipa industry by their discouraged owners. In every other direction, however, fish ponds in this region seem to be steadily increasing; at the barrios of Mayombo, Tambae, and especially at Tebeng, large areas have been developed, practically since 1903.

At the municipality of Binmaley are many ponds whose construction runs back indefinitely into Spanish times. In that direction also are many evidences of recent expansion. At Lomboy and Colmay several new dikes are in course of construction, and at Sabangan the largest pond of the section is being cleared. Lingayen and San Fabian have numerous ponds. A "regular price" for fish ponds about Dagupan is reported as 50 centavos per square meter.

The fish of most importance about the Gulf of Lingayen, as about Manila Bay, is the milkfish, or as it is called in Pangasinan, "betél." Mullets ("bulasi"), tenpounders ("bayerber"), various other species of fish of less importance, and shrimps are raised.

The marketable prices of betél seem to bring the same prices as the bañgos of the Manila market. Although more mullets than milkfish are taken from these ponds, the relative value is very different; the best mullets bring but 3 centavos, while the milkfish run as high as 30 centavos in large sizes.

POND CONSTRUCTION IN PANGASINAN.

In construction the ponds ("tagal" or "pococ") differ in many details from the ponds about Manila Bay. Rarely are the ponds entirely cleared; grassy islands and isolated nipa palms, left no doubt for shade, give an unkempt appearance. The dikes are as a rule not so massive or substantial as the Rizal dikes. Usually a retaining fence of split bamboo strips is first built to the line of high water. The strips eventually rot, leaving an unsightly double row of bamboo posts projecting a meter above the dikes. (Frequently the retaining fences are composed wholly of nipa palm; the stripped leaf-stalks being used for posts between which other leaves are woven.)

Other ponds are constructed in the interior of nipa swamps where the dikes need no protection whatever. The sluice gate, "paplagan," is a mere cut through the dike, with the sides protected by wattled split bamboo or sheets of cortex of the coconut. The floor of the sluice is raised sufficiently to form a dam-breast at half tide and below. The surface of this dam-breast is covered with round bamboo held down by stakes and laid with an outward spread and downward slope; over it the water runs with some violence at ebb tide.

This waterway is guarded by a V-shaped bamboo paling on the inside and is stopped by damming with clay, if desired. Often there is a second, deeper-cut sluice, which is kept stopped with clay until it is desired to drain the pond and catch the fish, at which time a bamboo inclosure, "balyboy," is placed in front of the opening and many of the fish rush into it against the stream; at low water eight or ten waders, with cast nets, called in Pangasinan "sabacol," capture any that remain in the pools of the inclosure. In addition to the balyboy, another method employed for taking the fish is a gill net stretched between two sharpened bamboo stakes. This net is called "tabal." The fish are driven into this by beating the water with sticks.

PANGASINAN METHOD OF REARING THE FISH.

The gates of the large ponds are opened at intervals to secure such fry as may enter, and these are cared for to maturity; several such "crops" are gathered in a year. These consist principally of mullets ("bullasi"), but also of tarpons (*Elops saurus* and *Megalops cyprinoides*), shrimps ("urang"), gobies ("bonor") and whatever else may have happened in.

The "lesá," or betél fry, are, in the Gulf of Lingayen, captured by pond owners in square-bottomed scoop nets walled up on three sides, called "casag," and planted in brackish wells (as at Tebeng) or in small ponds near the owners' houses. The fry are kept in the wells three weeks and fed two or three times a week, after which, having attained sufficient size to successfully cope with their carnivorous companions, they are put in the ponds. The largest are marketed in four months. This is due to the fact that many of the fry are somewhat advanced in age when captured and many have entered through the sluice of the pond of their own volition. The betéls in the ocean and rivers are very different from the betéls in the fish ponds. The latter are fat and have dark backs, whereas the others are thin and silvery.

A curious custom prevails of filling the large ponds with tree branches so as to hinder thieves from getting at the fish. This has all to be removed when the owner collects the fish for himself. Nipa palms are sometimes planted to afford shade for the fish. In the dry season pits are frequently dug to afford cooler water. The water of the ponds must be changed frequently.

OEDOGONIUM CULTURE.

The growth of the food alga, in native dialect called "lumoyac," seems to be the crux of the Pangasinan problem. Several of the natives claim that the water is too muddy for its growth in the rainy season, while others believe that the lack of salinity is the cause. This point needs investigation.

EMPLOYEES.

The watchers and caretakers are paid 50 centavos per day in this neighborhood; their time, however, is also taken up with the care of rice fields, coconut groves, and in catching fish by other methods.

ADDITIONAL VERNACULAR NAMES.

The names most frequently given for betél fry in Pangasinan are, "lesá," "dalagan," and "acta." Lesá seems to be a Pangasinan word denoting "uncertain origin," the common belief being that they fall in the first April rain; to substantiate this statement is pointed out the fact that the betél of the fish ponds never have roe. The name of the adult fish is sometimes mentioned and is given as "aoa" (spelled also "haoa," "aua," and "awa").[1]

CONCLUDING REMARKS.

The bañgos makes a very fair fish to fry or broil, but, like its not distant relative, the shad, it is well provided with small bones. The natives boil it in water and vinegar. It is also dried, and roasted when eaten. The entrails are sometimes removed and the visceral cavity filled with salt, in which condition the fish will keep for two weeks.

There are other ponds in the Archipelago, but Manila Bay and the Gulf of Lingayen are the only localities where the bañgos are cultivated to any extent. The natives of Capiz Province (Island of Panay) are reported to be endeavoring to get men who understand the bañgos pond to go there and teach them how to convert their extensive mangrove swamps into these more profitable ventures. This, it would seem, should be encouraged.

The many interesting problems which this little knowledge suggests have already taken form in experiments in the growing of the food alga and in feeding the fry; these are as yet too new to afford any definite conclusions. A careful investigation of the habits, food, and spawning localities of the adult "sábalo," as well as of the "limulocso" of Lake Taal, will undoubtedly prove of much interest.

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[1] The last form is identical with the native name for this fish in the Hawaiian Islands.

APPENDED NOTES.

CALENDAR OF FISH-POND INDUSTRY ABOUT MANILA BAY.

Month.	Temperature.		Rainfall (Manila).	Growth of the milkfish.	Remarks.
	Mean.	Daily range.			
	°C.	°C.	mm.	cm.	
April	28.3	8.9	28.4	1.5	Lent. Remaining stock is marketed.
May	28.6	7.0	101.6	4.0	
June	27.9	6.0	247.6	7.0	Fry may be procured. Fish grow most rapidly.
July	27.1	5.0	381.0	20.0	
August	27.1	4.8	361.2	29.0	
September	27.0	4.6	374.7	34.0	
October	26.9	5.6	191.8	39.0	Alga grows most rapidly.
November	26.1	5.7	136.5	41.0	
December	25.2	6.2	58.1	43.0	Best months for salt making and the salt-water fisheries.
January	25.0	7.6	29.0	44.0	
February	25.4	8.5	9.8	45.0	
March	26.8	8.6	18.6	47.0	
For the year	26.8	6.5	1,938.3	----------	

NOTE.—Meteorological data from "Climate," by Rev. José Algué, S. J., Director Philippine Weather Bureau, in "Census of the Philippine Islands," 1903, Volume I, page 87. Other data from native sources.

A MORE CRITICAL DESCRIPTION OF THE PREVIOUSLY MENTIONED SPECIMEN OF CHANOS CHANOS FORSKÅL.

Specimen 39 centimeters in length, from Malabon, Rizal, Philippine Islands. Head 4.5 in length; depth 4.35; D. II, 14; A. I., 9. Scales 14–88–18. Eye 3.5 in head; snout 3; maxillary 4; pectoral 1.6; ventral 2; caudal 1.4 as long as head; dorsal 1.25 in head; B. 4.

Body elliptical, moderately compressed; caudal peduncle slender; head pointed, rounded above (some poor-conditioned specimens are flat or rather concave); eye and side of head covered by a large, transparent, imperforate adipose eyelid merging with the translucent, adipose top of the head. This continues back, covering three rows of scales in the occipital region; mouth small, terminal, toothless, transverse, lower jaw included; maxillary broad, slipping under the adipose preorbital, without supplemental bone; opercle behind with membranous edge, in width 0.4 of eye.[1] Pseudo branchiæ very large; gill rakers fine and flexible; very close set, rather long; bones of gill rakers flexible; gill arches all connected by membrane.

Lateral line well developed; scales firm, cycloid, with strongly marked longitudinal striae; scales rather large, hard, firm, enameled; dorsal inserted somewhat nearer snout than base of caudal, before ventrals, its first ray falcate, its last one-half as long as its third, produced into a short filament. Base of fin with large, scaly sheath; pectoral and ventral each with scaly axillary appendages; anal similar to dorsal, but much smaller; pectorals and ventrals medium; caudal very long, forked to the base, its lobes subequal, straight, sprinkled quite thickly with small but conspicuous scales, each lobe provided with a pair of large, adipose, scale-like sheaths, projecting backward from the corners of the caudal peduncle. Ventrals somewhat falcate.

Color in life, silver, olive gray above, with deep and iridescent blue and olive reflections. Dorsal and caudal gray, the latter with no yellow; lower fins with some yellowish; pectōrals with minute gray spots.

Under a low power of the microscope fry from a palyok measuring 14 millimeters in length by 1.5 millimeters in depth with yolk sack unabsorbed looked not unlike the fry of the shad. They are sprinkled with minute spots above the lateral line and upon the fins, except the pectorals. There is a line of these spots which are more dense and darker in color, opposite to and extending the full length of the dorsal boundary of the visceral cavity from the base of the pectorals to the anterior base of the anal fin. More advanced in age, the dorsal spots form in lines extending from just above the lateral line upon one side to just above the lateral line of the other side, thus bridging the back in a close succession. This marking was very distinct in a specimen 21 millimeters in length, which closely approached the adult in its form.

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[1] This description varies little after the description of *Chanos chanos* Forskål, by Jordan and Evermann in "The Fishes of Hawaii," except here; in the work mentioned it is said "opercle truncate behind;" but upon closely examining the figure we see that the artist has interpreted a specimen to have a membranous edge to the operculum of about half the width of the specimen here described. Identification is, therefore, quite certain, especially as Drs. Jordan and Evermann report several specimens of only *chanos* from Formosa where Professor Mitsukuri refers to *salmoneus* of Bloch and Schneider. Our specimen is clearly *salmoneus* of Bloch and Schneider as set forth by Dr. Gunther in the "Catalogue of Fishes of the British Museum."

In Proc. U. S. Nat. Mus. XXXI, 1906, Evermann and Seale describing fish collected in the Philippines by Maj. E. A. Mearns, a specimen of *Chanos chanos* from Manila is described which proves to be of the same species as our specimens.

SYNONYMS, AFTER JORDAN AND EVERMAN.

Mugil chanos Forskål, Descript. Animal., 74, 1775, Red Sea at Djidda, Arabia.

Chanos arabicus Lacépéde, Hist. Nat. Poiss., V, 396, 1803. Arabia.

Lutodeira chanos Rüppell, Atlas zu der Reise in Nordl. Africa, 18, pl. 5, Fig. I, 1828.

Cyprinus pala Cuvier, Regne, Animal, ed. 2, 11, 22, 1829; after Russel.

Cyprinus tolo Cuvier, op. cit., 222; after Russell.

Leuciscus zeylonicus Bennett, Proc, Zoöl. Soc. Lond. 1832, 184. Ceylon.

Chanos mento Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 194, 1846, Ile de France.

Chanos Chloropterus Cuvier & Valenciennes, op. cit., 195. Madepolam.

Chanos muchalis Cuvier & Valenciennes, op. cit., 196. Vizagapatam.

Chanos orientalis Kühl in Cuvier & Valenciennes, op. cit., 197. Red Sea.

Chanos cyprinella Cuvier & Valenciennes, op. cit., 198. Honolulu, Hawaiian Islands.

Chanos salmoneous Cuvier & Valenciennes, op. cit., 201, 1846, between New Caledonia and Norfolk Island; Gunther, Rep. Shore Fish., Chall., Zoöl., I, Part VI, 61, 1880 (Honolulu).

Leuciscus (*Ptycholepis*) *salmoneus* Gray, in Dieffenbach Trav. New Zeal., II, 218.

Butirinus argenteus Jerdon, Madras, Journ. Lit. Sci., XV, 1849, 343. Madras.

Butirinus maderaspatensis Jerdon, op. cit., 344. Madras.

Chanos indicus Bleeker, Enum. Pisc. Arch. Ind., 160, 1859. East Indies.

Chanos Chanos Klunzinger, Verh. Bat. Zoöl. Gen. Wien, 1871, 605; Jordan & Evermann, Fishes North and Mid. Amer., I, 414, 1896; Steindachner, Denks. Ak. Wiss. Wein, LXX, 1900, 514 (Honolulu); Jenkins, Bull. U. S. Fish Comm., XXII. 1902 (Sept. 23, 1903), 432 (Honolulu); Jordan & Snyder, Proc. U. S. Nat. Mus. XXVII, 1904 (Oct.), 123. (Honolulu).

Chanos salmoneus Bloch & Schneider, is thus described by Dr. Gunther in a Catalogue of the Fishes of the British Museum, 1868: "B. 4; D. 13–17; A. 9–10; L. lat. 85–88 L. transv. $\frac{13}{16}$; vert. $\frac{19}{26}$. Uniform silvery. Indian and Pacific Oceans."

In addition to the thirteen references already given under *Chanos chanos* Forskål, Dr. Gunther cites the following:

Renard Poiss. d'Amb., fol. 34, No. 184.

Mugil chanos Bl. Schn., p. 116.

Mugil salmoneus (Forst.) Bl. Schn. p. 121; Forst. Descr. Animed. Lichtenstein, p. 299.
Chanos arabicus Lacep., v. p. 396; Cuv. & Val., XIX, p. 187.
Palah bontah Russell, ii, pl. 207.
Toolelvo Russell, ii, pl. 208.
Cyprinus (Leuciscus) palah Cuv., Régne Anim.
Lutodeira chanos Gunther, in Fish. Zanz., p. 120.
Lutodeira salmonea Richards, Voy. Ereb. & Terr., Icthyol., p. 58, pl. 36, fig. 1.
Chanos chloropterus Kner, Novara, Fisch., p. 341.
Chanos pala Cant., Mal. Fish., p. 278; Day, Fish Malab., p. 224.
Chanos tolo Cant., l. c., p. 282.
Chanos indicus Bleek, Verh. Bat. Gen. XXIV. Chiroc., p. 11.

We add also:

Chanos Salmoneus Gunther, Cat. B. Mus. VII, p. 473; Elera Cat. Sist. Faun. Filip. I, p. 585; Mitsukuri, Bull. U. S. Dept. Com. & Lab., Fur. Fish, XXIV, 1904, p. 277.
Chanos chanos Jordan & Evermann, Bull. U. S. Fish Comm. XXIII, part, 1, p. 57 (Hawaiian Islands); Jordan & Evermann, Proc. U. S. Nat. Mus., XXV, 1902, p. 327 (Formosa) Evermann & Seale, Proc. U. S. Nat. Mus., XXXI, 1906, p. 505 (Manila).

LOCAL NAMES.

English: milkfish.

Hawaiian: awa-awa; awa-kalamoku; puawa; awa.

Formosan Chinese: sabahi.

Philippine dialects: Tagalog: bañgos; bañgod; kawag-kawag; sábalo; limulocso (?). Pangasinan: betél; ampas; lesá, aoa (spelled also, haoo, aua, and awa). Visayan: bañgrús.

This fish is reported from the Philippines as follows: "Luzon, Estanques de Malabon, Manila," Elera, Cast de, Cat. Sist. Faun. Filips. p. 585, 1895. "Manila," Evermann & Seale, collection of Maj. Mearns, Proc. U. S. Nat. Mus. XXXI, 1906.

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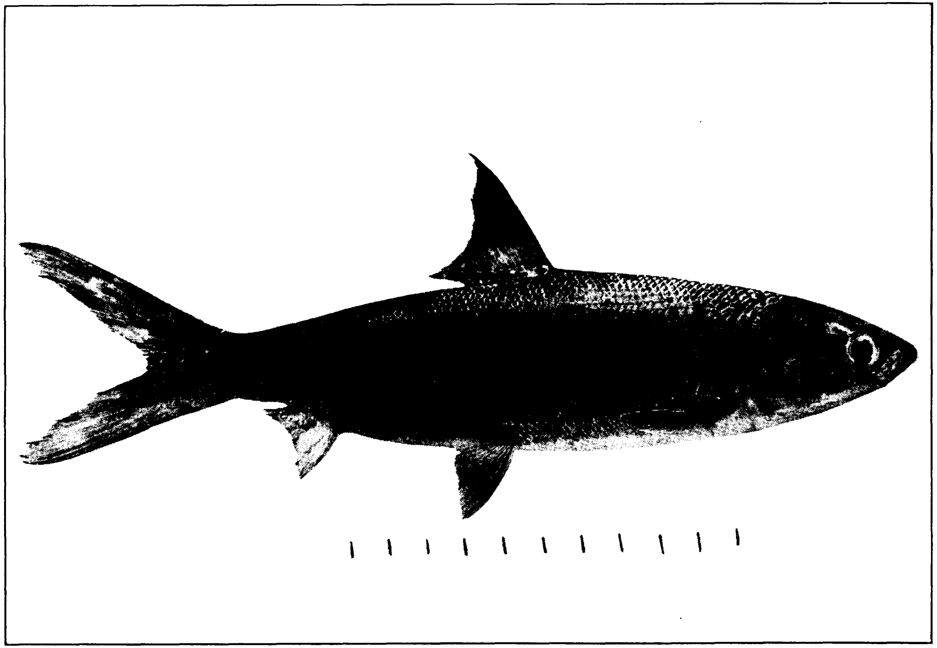
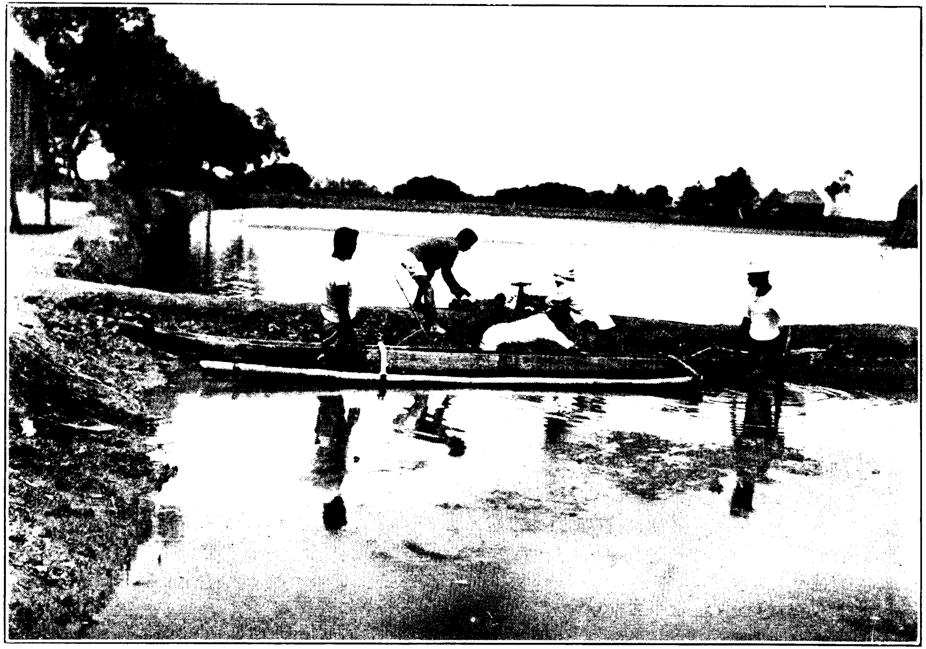
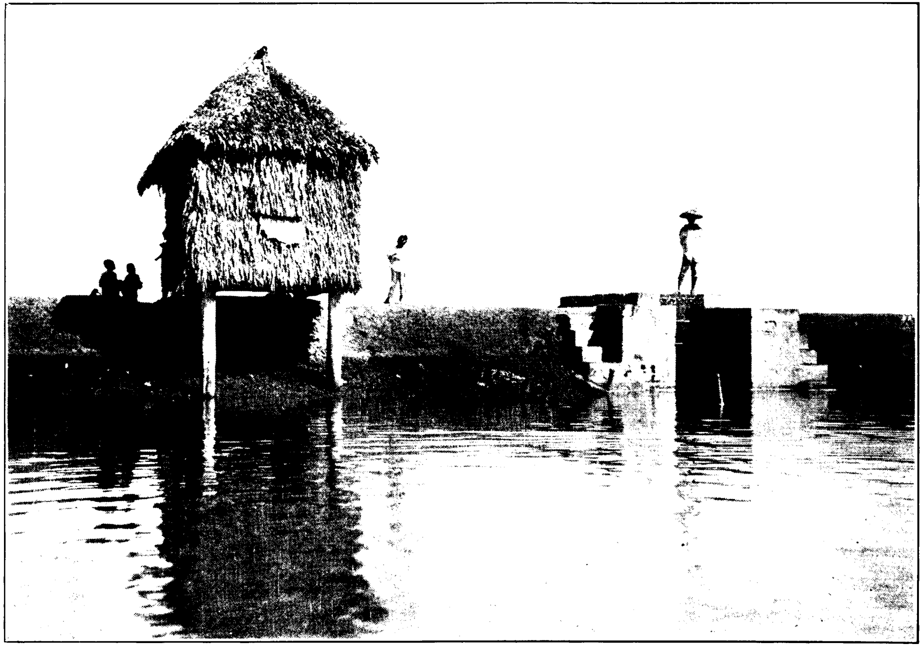


BAÑGOS (MILK FISH) OF THE SIZE USUALLY TAKEN FROM THE PONDS AND SOLD IN GREAT QUANTITIES IN THE MARKETS OF MANILA.

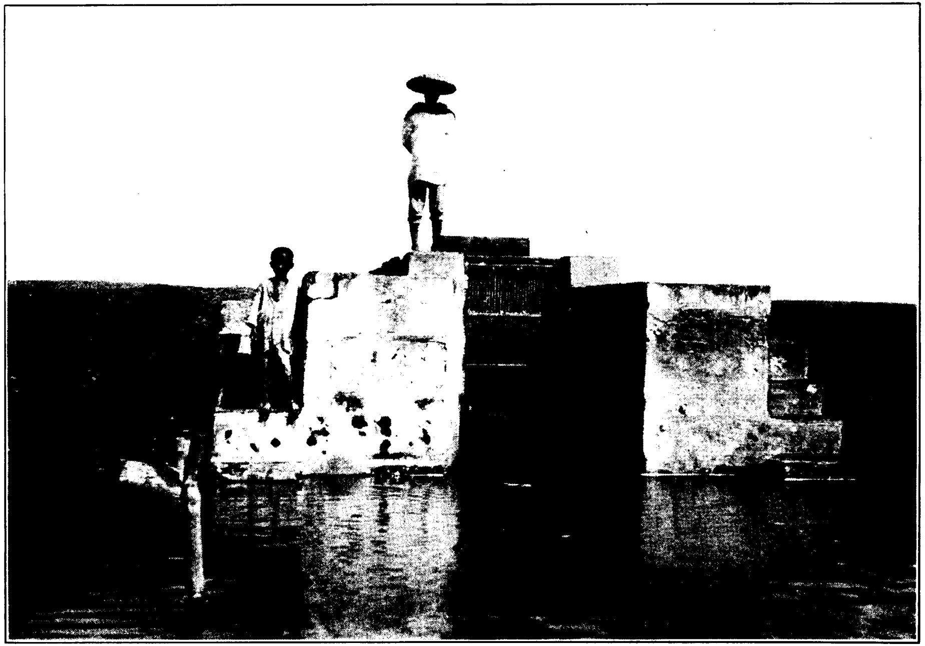


MEN AT WORK REPAIRING A PARTITION DYKE SEPARATING TWO PONDS.

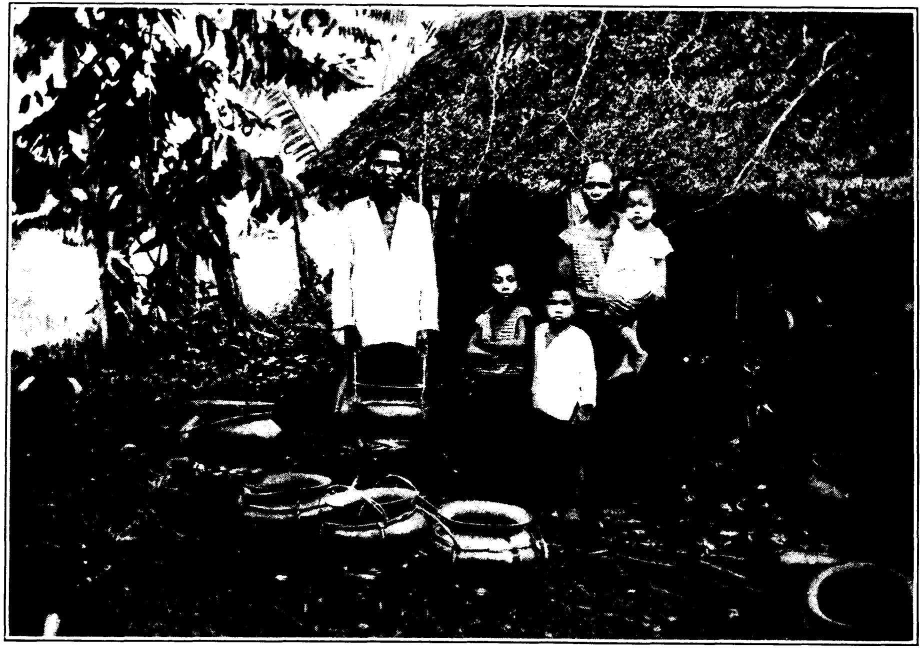


SHOWING MASONRY GATE AND SLUICE OF A FISH POND AT MALABON.

The small nipa house is the shelter of the guard who is standing on the gate. Many of these sluices are skillfully built of cement and stone.



ANOTHER VIEW OF THE SLUICE, SHOWING THE WICKER GATE WHICH PREVENTS THE ESCAPE OF THE FISH WHEN THE GATE IS OPENED FOR THE PURPOSE OF RENEWING THE WATER OF THE POND, AND THE WATER-TIGHT GATE JUST BACK OF THIS.



A VENDER OF MINNOWS HOLDING A "PALYOK" IN HIS HANDS.

In these palyoks, or jars, the minnows are shipped from the Batangas and other coasts for transfer to the ponds.